Armour, Swift, Burlington Bridge (A.S.B.)
Spanning the Missouri River from Locust
Street in Kansas City, Jackson County, to
Burlington Avenue in North Kansas City
Clay County
Missouri

HAER No. MO-2

HAER
MO,
48-KANCI,
16-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
ROCKY MOUNTAIN REGIONAL OFFICE
DEPARTMENT OF THE INTERIOR
P.O. BOX 25287
DENVER, COLORADO 80225

HISTORIC AMERICAN ENGINEERING RECORD

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Armour, Swift, Burlington Bridge (A.S.B.)
(Winner Bridge Missouri River Bridge)
(Fratt Bridge North Kansas City Bridge)

MO-2

Location:	Spanning the Missouri River from Locust Street in Kansas City, Jackson County, Missouri, to Burlington Avenue in North Kansas City, Clay County, Missouri. Sections 26 and 32, Township 50 North, Range 33 West. United States Department of the Interior Geological Survey, Kansas City Quadrangle.
Dates of Construction:	Stone Masonry Piers - 1890 Bridge - 1910-1912
Present Owner:	Missouri Highway and Transportation Department
Present Use:	Vehicular roadway on upper level with railroad on lower level. Lift span for river traffic.
Significance:	The A.S.B. bridge is the only vertical lift span of its type ever built with the railroad portion telescoping into the truss of the vehicular roadway so as not to interfere with vehicular traffic.
Historian:	Missouri Highway and Transportation Department, May 1982
Transmitted by:	Jean P. Yearby, HAER, 1984

INTRODUCTION

This historical record is compiled to fulfill a requirement of the Memorandum of Agreement of the Advisory Council on Historic Preservation dated January 30, 1981. This memorandum calls for a permanent record and history of the Armour, Swift, Burlington Bridge (A.S.B. Bridge) before it is significantly altered by the removal of the vehicular deck due to its condition. A new vehicular bridge is to be constructed immediately adjacent to the present structure.

The contents of this record are prepared in accordance with standards established by the Historic American Engineering Record, National Park Service, for compliance with Executive Order 11593, Section 2(c).

The location of the bridge and its role in the development of the region, the history of the bridge and its developers, along with a description of the structure itself will be covered.

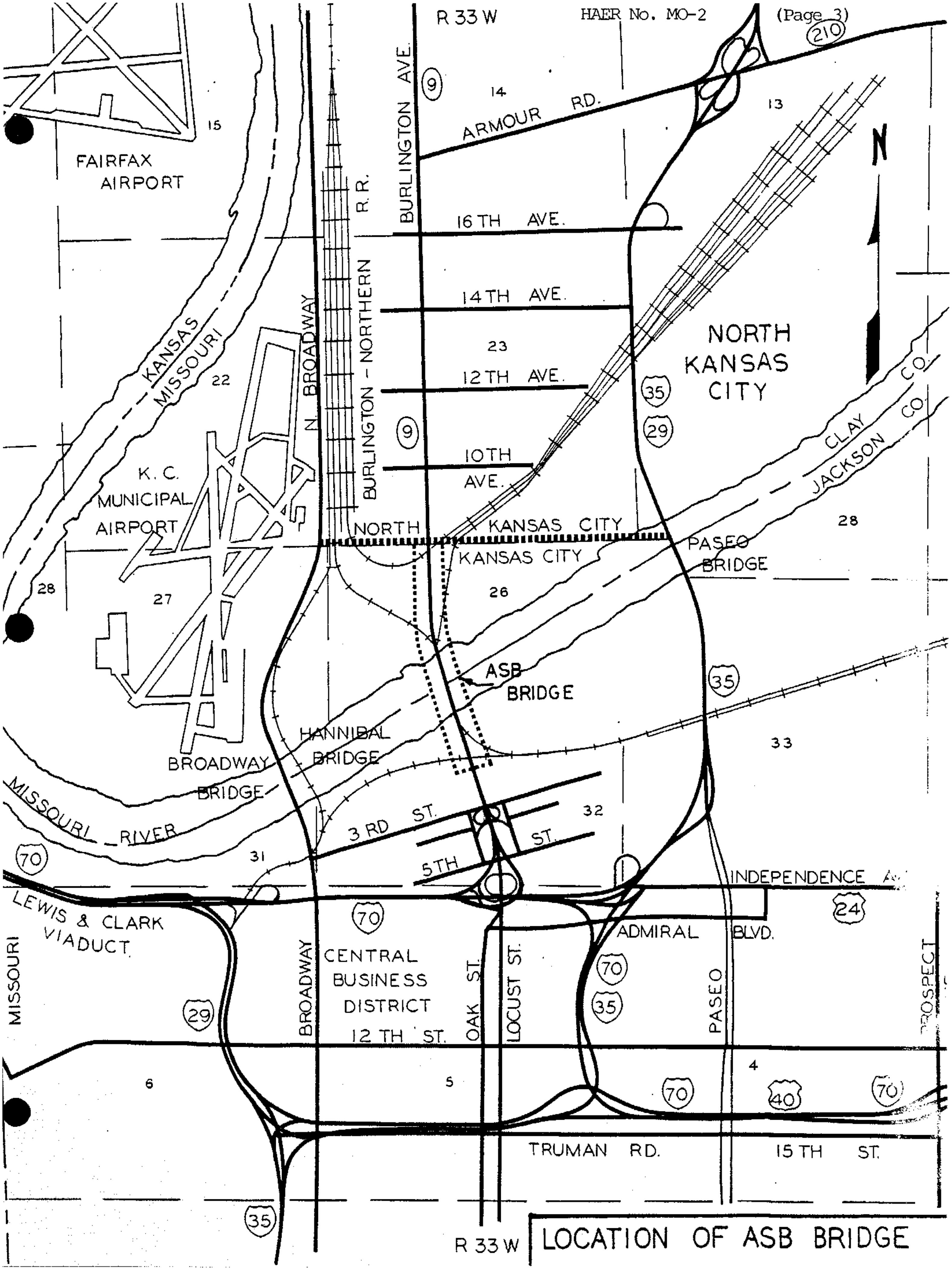
The need for the new vehicular bridge was brought about by the deteriorated and unsafe condition of the vehicular portion of the A.S.B. Bridge. Under agreement with the Burlington Northern Incorporated, dated January 4, 1980, the Missouri Highway and Transportation Commission agreed to remove the highway from the upper level and remove all portions of the A.S.B. Bridge, including approaches which are not required to support the railway tracks, and to make necessary repairs to bring that portion of the bridge (the three river spans) to a good state of repair for use by the railroad. Upon rehabilitation of the railroad portion of the bridge, the Burlington is to assume ownership of the structure and provide for its continuing maintenance and use for railway traffic.

The rehabilitation of the remaining railroad portion of the structure involves the replacement of the deteriorated steel members in kind and the cleaning and painting of the structure. This will serve to retain and increase the life span of the railroad bridge, including the unique lift span. The significant portion of this historic structure will be preserved by the rehabilitation.

It has been determined that the bridge is eligible for the National Register of Historic Places and this documentation will constitute adequate mitigation of the adverse effect.

LOCATION

The A.S.B. Bridge corridor, since the construction of the bridge, has led an important role in the development of Kansas City. The corridor, shown on the location sketch on the following page, begins on the north side of the Central Business District at the



LOCATION OF ASB BRIDGE

interchange of Missouri Route 9 (Locust Street) and Interstate Route I-70. This interchange, since constructed, has been known as the A.S.B. interchange and provides ingress and egress to the downtown area as well as the roadway system distributing traffic to the areas south of the Missouri River. Route 9 crosses the Missouri River on the bridge and continues northerly on Burlington Avenue in North Kansas City. Route 9 is an important artery carrying traffic to and from the north from various communities in Clay and Platte Counties. The bridge carried an average of 32,080 vehicles per day in 1981, and 25 to 30 freight trains daily on its lower level.

HISTORY

In 1887, Congress authorized the construction of what is now known as the A.S.B. Bridge. The original bill granted to E. L. Martin, T. B. Bullene and William B. Chambers this authority, but the bill was later amended to substitute the Wabash, St. Louis, and Pacific Railroad Company for the three men.[1]

J. A. L. Waddell was retained to design the bridge, which, at that time, was to be a high level, single track railroad bridge with a vehicular roadway astride of each truss. Construction was started on nine tapered stone masonry piers which were completed in 1890. Waddell later described these as "Cocked hat" piers designed to relieve the monotony of appearance in a tall shaft, however, he later felt they were an architectural extravagance and should be avoided from an economic standpoint. Years later, four of the river piers were cut down to an elevation of ten feet above the high water mark to accommodate the wider truss of the present bridge and allow for a two level structure. Waddell was also the designer of the present bridge and felt his earlier design of the piers was fortunate as the lowered piers provided sufficient width for the new double track truss.[2] One of the original piers not used in the present structure was short, but the adjoining land has since been filled by sedimentation from floods on the river prior to the levee system now in place.

Upon completion of the piers, the control of the bridge passed to the Kansas City Bridge and Terminal Railway Company, whose president was Willard E. Winner.[3] Winner was active in real estate development in Kansas City area and at this time envisioned the development of what is now North Kansas City in Clay County.[4] The bridge was part of his plan for development and the bridge became known as the Winner Bridge. In 1894, Waddell was again retained to design a different structure for the earlier piers. The bridge was to contain two railroad tracks with a lifting deck built at the level of the river valley and two electric interurban car tracks and a vehicular deck with sidewalks on the upper level. This bridge is described in De Pontibus written by Waddell.[5] Due to financial difficulties, the bridge was never built and, in 1901, Winner lost his holdings through foreclosure of the mortgages to the Kansas City and Atlantic Railroad Company.[3]

During the succeeding years, the bridge property passed through various holdings until the two packing companies of Armour and Swift, and the Burlington Railroad acquired the site and piers in 1903.[3] They incorporated under the name of the Union Depot, Bridge, and Terminal Railway Company. It was not until 1907 that F. W. Fratt, then president of the company, approached the newly-formed firm of Waddell and Harrington to make a study and estimate the cost of finishing the Winner Bridge.

In the intervening years between 1894 and 1907, many changes came about in bridge design due to improved materials and construction practices. Steel had become an accepted structural material and riveted connections replaced the traditional pin connections. The early twentieth century bridges were transitional between the influence of the railroad bridges of the past century and the modern highway bridge. It was during the later part of this period that vertical lift bridges began to be used extensively.[6] Waddell had designed and built a major vertical lift bridge, the South Hallstead Bridge in Chicago in 1892, this was the first important vertical lift bridge to be constructed in the United States. Waddell had patented his design, preventing other engineers from entering the field during the period. He was also unsuccessful during this time in building similar bridges due to political and financial conditions of such a nature that his engineer's conscience prevented him from dealing with the parties interested.[7]

In the redesign of the Winner Bridge, now called the Fratt Bridge, the advances made in bridge design over the previous years were applied. Riveted design was adopted, telescoping the hangers inside of the vertical post of the supporting trusses instead of letting them pass outside, using concrete instead of cast-iron counterweights and placing them at the ends of the span instead of at the panel points, operating from a machinery house at each end of the span, instead of from a single house at mid-span, and using wire ropes instead of shafting for the transmission of power.[8]

The owners decided to proceed with the bridge, but could not visualize from the drawings the operation of the vertical lift span. A scaled working model was made and gave a perfect demonstration of the operation. They were not satisfied with the demonstration until a committee of experts in the field of Civil and Mechanical Engineering from around the country gave its unanimous approval.[9][10]

Work began on the bridge in 1909 and it was opened to traffic on December 28, 1911. Tolls were charged for use of the upper deck by vehicles, pedestrians and livestock.

Events and Alterations

1913 January	Electric interurban cars began use of rails on upper deck.
1927 May 2	South approach span damaged by fire.[11]

1927 August	Bridge taken over by the State Highway Department and tolls removed. Bridge floor replaced under Project US71-S44.
1932	Steel girder span over Second Street replaced under Project R-71-S26.
1934	North approach widened, Project 71NRM-6-C.
1948	Bridge deck replaced, repairs to bridge and new lighting. Street car tracks removed, Project F-394(1).
1949	Collars placed around river piers to prevent erosion, Project F-394(3).
1950	Bridge cleaned and painted, Project F-394(3)b.
1952	North approach widened, Project Sec. 44A.
1966	North approach widened and resurfaced, Project Sec. 24(1).
1967	Bridge deck repaired, Project CO48-71(8).
1981-1982	Repair of girder lines supporting railroad on downstream side of railroad deck, Project 4-U-251.

ENGINEERS

John Alexander Low Waddell

(1854 to 1938)

J. A. L. Waddell was born in Port Hope, Ontario, Canada. He received his education in public and private schools in Port Hope where, due to his mathematical ability, he was encouraged to obtain the best available training in engineering. In pursuing his engineering education, he obtained a Civil Engineering degree from Rennselear Polytechnic Institute in 1875, a Mechanical Engineering degree in 1882 from McGill College, and a Doctor of Science and L.L.D. from the University of Missouri in 1904, and a Doctor of Engineering from the University of Nebraska in 1911.

The early years of his career were devoted to teaching. He spent six years after his graduation from Rennselear with the school as an instructor. After a brief period with a consulting engineer, he went to Japan where he spent four years and established a Civil Engineering curriculum at the Imperial University of Tokio.

In 1887, he chose Kansas City as the location for establishing his consulting firm in association with the Phenix Bridge Company. It was during his years in Kansas City that he attained his worldwide reputation as a bridge engineer. It was during this time that he obtained his patent for the vertical lift bridge. He was also instrumental in the development of nickel steel for bridges. Due to his worldwide consulting practice, he moved to New York in 1920. At the time of his death in 1938, he was supervising designer for the New York World's Fair.

He has to his credit several engineering books and technical papers, some of which are listed in the bibliography. His ability was recognized worldwide and in appreciation he was decorated and honored by several countries. [12][13][14][15][16]

John Lyle Harrington

(1868 to 1942)

John Lyle Harrington was born in Lawrence, Kansas. He received a degree in Civil Engineering from the University of Kansas in 1891.

While a student, he worked for J.A.L. Waddell without pay during the summer months. Upon graduation, he was employed by Waddell and during the next twelve years with various other firms. In 1905, he became Chief Engineer and Manager of the Locomotive and Machine Company of Montreal. In 1907, he formed a partnership with Waddell.

The mechanical mechanism of the bridges designed by the firm was the work of Harrington. The lifting machinery on the A.S.B. Bridge was one of his early designs.

The association with Waddell ended in 1914, with the formation of the firm of Harrington, Howard and Ash. The bridges designed by this firm were built throughout the United States and Canada. Following World War I, several bridges were constructed over the Don River in Russia which contributed to that country's industrial growth.

In 1928, the firm of Harrington and Cortelyou was formed, and it is still a recognized bridge consulting firm in Kansas City. [17][18]

Frederick W. Fratt

(1859 to 1942)

Frederick W. Fratt was born in Racine, Wisconsin. He received his education at Wisconsin State University, graduating in Civil Engineering in 1882.

His principal interest was in railway work and especially in rail electrification. He held positions with the Chicago Northwestern Railroad, Wisconsin Central Railroad, Missouri-Kansas-Texas Railroad and the Northern Pacific Railroad. In 1906, he became president of the North Kansas City Bridge and Railroad Company and the North Kansas City Development Company which was an Armour, Swift, Burlington interest. It was during his tenure as president of this company that the A.S.B. Bridge was constructed under his supervision.

He retired from his position in 1917 to pursue his personal investments and specialize in investigations as a Consulting Engineer.[19][20]

DESCRIPTION OF STRUCTURE

The structure is composed of three different parts, the south approach, three river spans, and the north approach. The entire length of the bridge is 4,083 feet. The length including the approaches from 3rd Street in Kansas City to 10th Street in North Kansas City is 1.2 miles. For the purpose of this description, each part of the bridge will be covered separately.

RIVER SPANS

This is the bridge proper and consists of two decks, the lower deck carries a single railroad track at the present time, but initially it was built with double railroad tracks. After this structure is rehabilitated and made structurally sound, consideration is being given by the railroad to reinstalling the second track. The upper deck originally provided for double track electric interurban cars in the central roadway with vehicle lanes and sidewalks on the outside. The rails were removed in 1948 and the center portion paved to provide four vehicular lanes. The upper deck continues onto the north and south approach. The length of the lift span is 428 feet and the two fixed spans 428 feet and 426 feet respectively, for a total length of 1,282 feet.

Substructure

Four of the original limestone masonry piers built in 1890 were modified and used for the river spans as they were in good condition. These are piers 4, 5, 6 and 7. Originally, pier 3 was in the river, but after the piers were constructed, harbor lines were established by the government and extensive reclamation work confined the river to about three-fourths of its original width. The piers rests on bedrock 50 to 60 feet below low water. The piers were cut down to below the starlings and capped with concrete cappings.

Superstructure

The superstructure consists of three truss spans. Two of the truss spans are fixed and carry the highway deck at the top chord and the railway deck on the bottom chord. The third span, which is the unique portion of the bridge because of the lifting railroad deck, is placed at a higher elevation so that its lower chords are just below the upper deck. The railway deck of this span is suspended from the main truss. The railroad deck, when raised, provides a vertical clearance of 65 feet above standard high water and a navigable channel of 412 feet between piers.

The railroad deck on the lift span is composed of four lines of continuous stringers riveted into the cross floor beams. Each floor beam is suspended from the truss above by two stiff member hangars that rise into the truss post above them when the deck is lifted.

When in a down position, the loads on the railroad deck are transmitted to the trusses of the supporting span through pins in the tops of the hangars which rest in sockets on pairs of diaphragms in the truss post.

The lifting deck is guided in its up and down movements by four castings at its four corners, attached to the lower chords. The four castings move over angles on the main columns. Near the lower ends, these vertical guides flare out slightly and bring the deck to an exact lateral position at it approaches its rest.

The railroad deck is raised by two 1-1/2-inch cables which are attached to the hangars. At the ends of the lifting deck, no hangars are used, but the cables extend down and connect to the end floor beams. The cables pass up through the truss post and go over an idler sheave on the top chord. One-fourth of the cables go to the nearest adjacent corner of the span where they pass over a grooved drum. From the drum the cables pass over idler sheaves on the upper roadway level and down to the counterweights. Each floor beam's dead load is balanced by two counterweights which hang in four groups of eight, each at the ends of the truss on both sides. The counterweights are of concrete and are guided by small jaw guides which engage on vertical tracks of Z-bars attached to the bridge. The deck and hangars are made of nickel steel to reduce the weight and weighs 800 tons. Each of the larger counterweights weighs 25 tons.

Hoisting Machinery

Duplicate hoisting machinery is housed in sheds on the upper chords at both ends of the truss. Operation is effected by rotating the corner drums which are driven by a 125 hp. electric motor whose power is transmitted through a train of gears to a common drive shaft to which the drums are attached. The friction of the suspending cables on the drums is sufficient to raise and lower the deck. Initially, the deck could be raised in 50 seconds, but due to the age and condition of the machinery, it now takes about three minutes. The synchronization of the two sets of machinery at either end is handled by a counterweighted rope drive connecting opposite motor shafts. The motors are connected electrically and both operate simultaneously. In case either should be out of service, the lifting deck can be operated by a single motor from either end, the machinery at the opposite end being operated through the rope drive. Limit switches cut off the current to the motors and apply the brakes near each limit of movement.

Initially, the deck could be lifted by means of capstons at each end of the bridge. It required eight men on each capston to raise the bridge. This mechanism is no longer operable.

A mechanical indicator is located in the machinery house which indicates the position of the lifting deck when in operation. This device is no longer used as the operation of the lifting deck is now done from the railway deck.

No longer used is a device to lock the deck in place when in a down position. Some of the parts are still in place on the structure, but most have been removed. The hangar locks consist of pairs of cams swinging on shafts in the post, so as to bearn on slot castings on the hangars. This was connected by a rod to a series of levers and rods located on the top chord. End locks on the piers were also employed. Motor operated machinery, located in the south machine house, drew the locks.

Rail locks are in use on the tracks. Electric motors first lift the lock rail clear of the lift span when it is raised. The original locks have since been replaced.

The operation of the lift deck and rail locks is controlled from a tender's house located on the railway deck.

Deck

The trusses on the lift span are on 32-foot centers. This allows for a 24' concrete pavement between curbs within the trusses. The outside roadways are cantilevered out from the truss and provide for a 13'6" roadway between curbs. Sidewalks 3'9" wide extend beyond the roadway. A lattice type rail is provided on the outside.

Electric lines in conduit are suspended from the lower chord of the truss. Telephone lines in conduit are suspended beneath the cantilevered roadways. A natural gas line is also suspended from the cantilevered roadway on the downstream side. These utilities will be removed from the bridge when the roadway deck is removed.

The roadway on the top chord of the fixed trusses is very similar. The top chord separates the center lanes from the cantilevered outer lanes.[21][22][23]

SOUTH APPROACH

The south approach consists of the following spans: 2 plate girders totalling 92', 1, 285'11" through truss, 5 plate girders totalling 287' and 6 plate girders totalling 428', for a total length of 1,093 feet. There is also a short through girder span over the Kansas City Southern Railroad tracks which occupy the location of Second Street. The original superstructure of the bridge at this location was replaced in 1932.

Substructure

The end abutment A3 is of concrete with pile foundation. Three of the original stone masonry piers were utilized in the approach with some alteration to increase their height. Those are piers 1, 2, and 3. The area was filled to about the elevation of the starlings after the piers were constructed. The remaining bents supporting the superstructure are typical of steel bents built during this period. These bents rest on concrete pedestals supported on concrete or timber piles. The substructure for the east bound lanes of the Lewis and Clark viaduct (Interstate I-70) are of similar type, and was also designed by Waddell.

Superstructure

The viaduct structure is of the plate girder type supporting the center roadway. The outer lanes are carried on a cantilevered section outside the girders. A through truss spans the tracks of the I.C.G. Railroad, Kansas City Terminal Railroad, and the Missouri Pacific Railroad.

Deck

The concrete deck on both the girder spans and truss are similar to the deck on the river spans.

NORTH APPROACH

The north approach which is 1,707 feet long is made up of 25 plate girder spans totalling 1,399 feet, a through truss 129 feet in length, and 5 plate girder spans totalling 173 feet. The alignment of the viaduct curves after leaving the river spans to match Burlington Avenue which is oriented in a north-south direction.

Substructure

The north abutment A5 is near the city limits just inside North Kansas City. It is of concrete on a foundation of piles.

The remainder of the substructure is different from the south viaduct in that four tower bents are utilized. These towers are about 340 feet apartment with intermediate single bents between them. Piers 8 and 9 for the truss are of concrete on pile foundation.

Superstructure

The superstructure is the same as on the south viaduct. The through truss spans the tracks of the Burlington Northern Railroad on a slight skew.

Deck

The deck is of the same construction and section as on the south viaduct. A steel staircase is provided on the viaduct near pier 7 on the west side to provide access from the roadway to the ground level.

Materials and Cost

The following are approximate quantities of material used in the original structure:

Superstructure

Two fixed spans	8,037 tons
Lift span	
Carbon steel	4,203 tons
Nickel steel	346 tons
Machinery	292 tons
South viaduct	885 tons
South viaduct truss	1,617 tons
North viaduct	2,460 tons
North viaduct truss	236 tons
Total superstructure	18,076 tons

Miscellaneous

Concrete in side roadways	13,500 sq. yds.
Concrete in sidewalks	2,100 sq. yds.
Concrete in counterweights	360 cu. yds.
Substructure masonry	29,000 cu. yds.
Timber piles - 336	13,500 lin. ft.
Concrete piles (Chenoweth) 1,395	38,600 lin. ft.
Creosoted timber	950,000 ft. B.M.
Untreated timber	250,000 ft. B.M.
Paint	50 tons

The steel used in the superstructure was of carbon steel. The nickel steel used in the lifting deck and hangars contained 3.5% nickel.[25]

The original stone masonry piers cost $600,000. The remodeling of these and construction of the new ones come to $135,000. The total cost of the structure was $2,400,000.

The contractor for the substructure was James O'Connor and Son. The fabrication and erection of the substructure was done by McClintic - Marshall Construction Company.

CONCLUSION

The removal of the deteriorated vehicular portion of present bridge from the river spans will reduce the loading on the trusses. Along with the rehabilitation work to be done on the river spans, this will provide a sound structure for the use of the railroad and preserve the significant part of the structure by extending its life. This will be a contribution to the preservation of a historical structure and unique design of the lift span.

This record will document the structure as originally built for study by future generations.

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Bridge plans from the files of Burlington Northern Incorporated and Missouri Highway and Transportation Department.